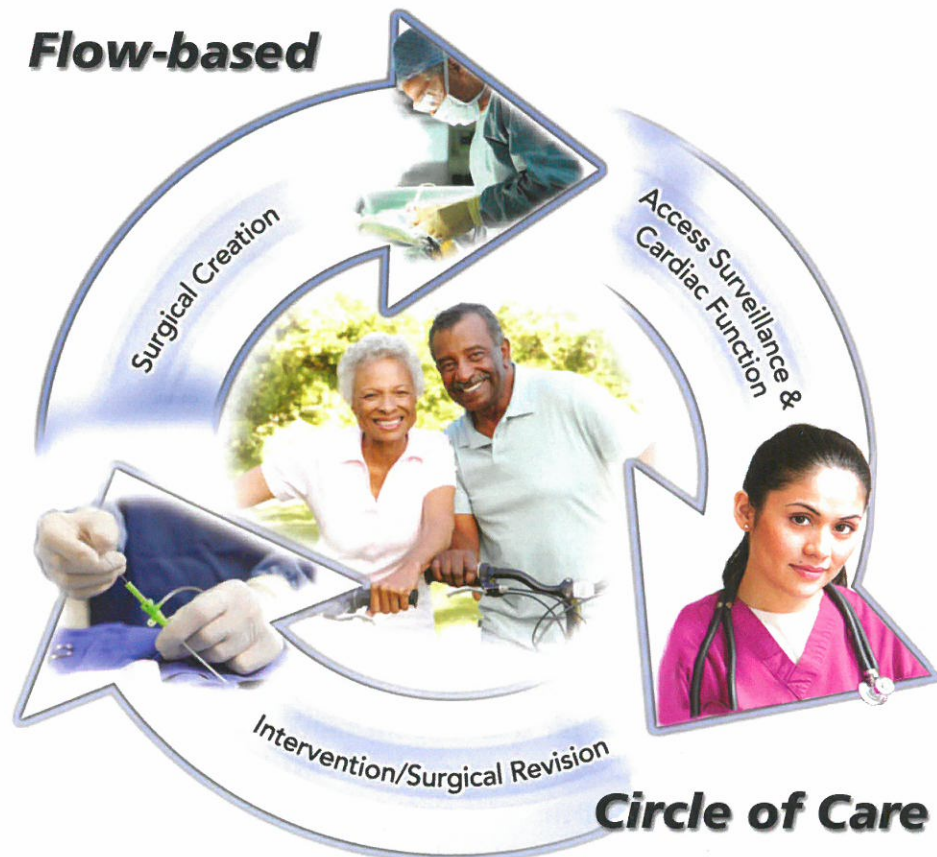


Vascular Access Management "A Circle of Care[®]"



Proactive vascular access management depends upon a trio of Transonic[®] flow measurements that guide the surgeon, the nephrologist and the interventionalist throughout the natural history of a vascular access.

- Surgical creation of AV access: Transit-time ultrasound (intraoperative) flow measurements foretell successful maturation.
- During hemodialysis: Transonic[®] ultrasound dilution measurements provide ongoing surveillance and trending to detect development of hemodynamically significant stenoses.
- Intervention/Revision: When an access problem is identified, intragraft flow measurements guide the interventional radiologist during percutaneous transluminal angioplasty (PTA). Intraoperative flow measurements guide surgical revisions to resolve complications such as "steal" syndrome.

Vascular Access Management

AV Access Creation, Surveillance

Access Creation: Intraoperative Blood Flow Measurements

The Centers for Medicare and Medicaid Services (CMS) Fistula First Break-through Initiative's success has transformed the hemodialysis access in the United States from a "graft-oriented culture" to a "fistula-oriented culture." Since 2012 more than 60% of American hemodialysis patients have AV fistulas.¹ Yet, the number of fistulas that do not mature (estimated to be between 28-50%)² continues to confound and challenge the hemodialysis care provider.

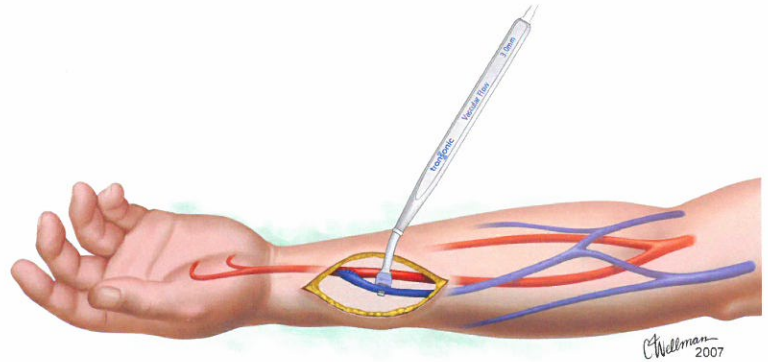


Fig. 1: Measuring arteriovenous (AV) fistula venous outflow with Transonic® Perivascular Flowprobe.

In his landmark 1998 study in *Surgery*, Johnson *et al* reported that for an AV fistula to mature, a venous outflow equal or greater than 100 mL/min at its creation is advised. For an AV prosthetic graft, an initial venous outflow of less than 250 mL/min is associated with a higher rate of initial graft failure.³ As the access matures and arterializes, flow generally increases to levels needed for hemodialysis (greater than 500 mL/min). To ensure adequate flow for hemodialysis, Transonic® intraoperative blood flow measurements provide the surgeon with quantitative flow values during creation of the access (Fig. 1). Johnson and others report that intraoperative blood flow rates at access creation directly correlate to access outcomes including: patency, number of interventions, and length of hospital stays.

"Adequate blood flow in peripheral hemodialysis fistulae and grafts is vital to the success of hemodialysis and to the survival of the patient. Reduction in flow ... presages failure of the access device itself. Access flow can therefore be considered a fundamental property of the access that should be monitored." Depner, TA *et. al.*

"A Circle of Care[®]"

Intervention and Revision

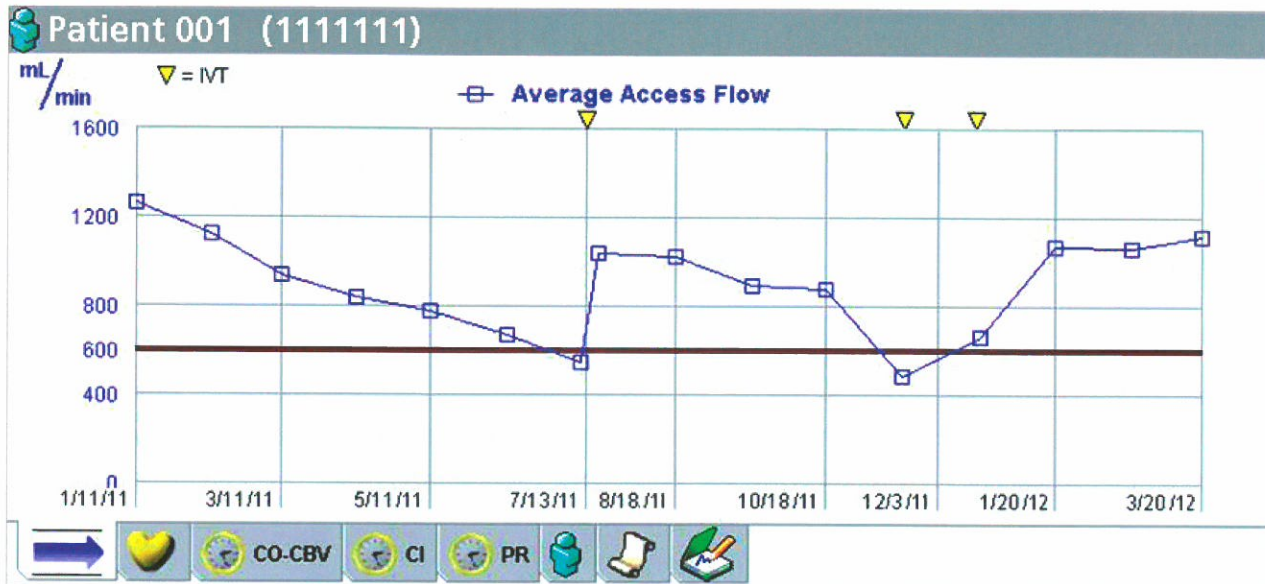


Fig. 2: Trending of vascular access flow over a one year time frame with PTA interventions noted by arrows.

Hemodialysis: Surveillance

The Kidney Disease Outcomes Quality Initiative (KDOQI) Clinical Practice Guidelines for Vascular Access and the National Kidney Foundation codified Dr. Depner's advocacy of access flow monitoring by stating "prospective surveillance of AV grafts and fistulas for hemodynamically significant stenosis, when combined with correction, improves patency and decreases the incidence of thrombosis."⁵ Canadian, Australian and European Guidelines also call for surveillance during hemodialysis to forestall stenosis formation and prolong the life of the access. Intra-access measurements (ultrasound dilution technology) are cited as the preferred method for surveillance.

Trasonic's ultrasound dilution technology is recognized as the "gold standard" intra-access flow measurement technology for hemodialysis patient surveillance.⁶ The method uses Trasonic Flow-QC[®] Hemodialysis Monitors and Flow/dilution Sensors to directly measure dialysis adequacy (delivered blood flow, recirculation) for on-the-spot correction of problems during hemodialysis and to trend vascular access flow to detect flow limiting problems wherever they occur in a vascular access (Fig. 2). Cardiac output and associated parameters can also be measured with this technology during the dialysis treatment.

Vascular Access Revision

Intra-graft Flow Measurements

During angioplasty, a Transonic® ReoCath® Flow Catheter and Endovascular Flowmeter provide the interventionalist with immediate flow feedback (Fig. 3)⁷ for quantitative confirmation that a hemodynamically significant stenosis has been corrected or that elastic recoil has not compromised the flow correction.

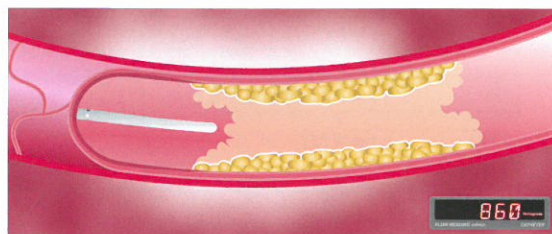


Fig. 3: ReoCath® Flow Catheter measuring intragraft flow post-angioplasty.

Intraoperative Flow Measurements

When surgery is the access revision option, intraoperative flow measurements inform during the revision. Transonic® quantitative measurements replace guesswork especially when an access needs to be banded to mitigate ischemic steal syndrome.

Conclusion

In the outcomes-driven climate of proactive end-stage renal disease (ESRD) care, Transonic® quantitative flow measurements are integral to successful and comprehensive vascular access management. During creation of the access, during hemodialysis and/or during interventions or revisions, respective Transonic® flow measurements inform and guide the surgeon, nephrologist and/or interventionalist as they seek to create and maintain a healthy access for their patients. Transonic® flow-based “Circle of Care” is a cornerstone for proactive Vascular Access Management.

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Transonic Systems Inc. is a global manufacturer of innovative biomedical measurement equipment. Founded in 1983, Transonic sells “gold standard” transit-time ultrasound flowmeters and monitors for surgical, hemodialysis, pediatric critical care, perfusion, interventional radiology and research applications. In addition, Transonic provides pressure and pressure volume systems, laser Doppler flowmeters and telemetry systems.

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